Understanding Critical Factors for Adoption of Cloud Computing in Enterprise Environment

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Abstract—**The advancement in cloud computing technology over the past few years is potentially one of the most significant advances in the history of computing. To avail benefits of cloud computing, a clear understanding of critical factors that impact on adoption of cloud technology. While a lot of research is currently taking place in the cloud technology itself, there is an equally urgent need for understanding local/global trends and challenges in cloud computing. This paper presents a literature survey highlighting the factors influencing enterprises for moving towards cloud. The aim of this article is to identify the critical factors, which act as key drivers for adoption of cloud technology for local enterprises and investigate the current cloud computing challenges in novel way. The results show that most of the enterprises move towards cloud technology considering, cost reduction, ubiquitous access, scalability and flexibility. Due to lack of cloud knowledge, limited resources, lack of management support and data security issue over cloud most of the organizations are unable to avail the benefits of cloud computing.**

Keywords—Cloud adoption challenges, Cloud Computing technology, Trends in cloud computing.

I. INTRODUCTION

Continued innovation is the major driving force for the creation of new products & services, developing new industries and supporting organizations competitiveness. Cloud computing is also one of the most innovative creativity in the history of information technology and computation [1] . Research in cloud computing has become an exciting area due to its novelty and growth. "Cloud computing" offers on-demand computing services with smaller number of IT staff, less maintenance, and quick implementation [2]. Rapid progress in storage and processing technology has been the major reason success of cloud computing. Cloud allows easy cheap, powerful and ubiquitous availability of remote resources. Cloud data centers deploy thousands of computers and can scale up quickly with increase in to demand of the service. Scalability requires appropriate processing time within limited cost in terms of hardware and energy. [3]. Cloud computing is the advance form of gird, utility and distributed computing. cloud services are embedded in our daily usage procucts such as: Facebook, YouTube, Twitter, Google Apps and Gmail [4]. Proliferating use of cloud services becoming a global trend in technology. Cloud computing allows sharing of virtual resources based on PAYG (Pay-as-you-go) method. Generally, cloud services are referred as SaaS (Software as a service), PaaS (Platform as a service) and IaaS (Infrastructure as a service) [5]. Based on the business needs, customer can select the service model. SaaS platform provides flexibility, scalability and cost effectiveness. PaaS offers a place where a consumer can develop applications on a service provider's computing platform, hence removing the requirement to find its own infrastructure for the development. In this way PaaS makes the deployment, development and testing of applications in cost effective, simple and quick. IaaS permits enterprises to rent a data center, without worrying about the need to maintain and create the same data center footprint in their own enterprise. Advantages of implementing IaaS include: scalability, optimal utility, improved throughput, reduced latency, cost effectiveness, simplified interface and much more [6].The development in cloud computing over the last five years has made a remarkable impact on the Information Technology (IT) industry. Now companies need to reshape their business paradigm so that they can achieve maximum advantage from latest technologies. Many companies like

Amazon, IBM, Microsoft and Google are striving to deliver cost effect cloud solutions. [3].

This study investigates the current trends and challenges in cloud computing and discusses various directions for future research. This study also investigates the reasons for cloud adoption in local IT companies and consolidate the existing research to present a brief review on adoption of cloud computing in multiple regions.

Section I describes the overview of cloud computing. In Section II literature review and state of the art of cloud computing is presented. Section III explain the factors affecting adoption of cloud computing in local industry. Section IV gives conclusion and limitation of this study.

II. RELATED WORK

The advances in cloud computing are revolutionary the world in general, but there are many challenges that need to be addressed including security, resource management by the research community. Brüggemann, T. present state of the art of cloud computing including its core concepts, design, cloud characteristics, technologies and gives future directions. Many challenges related to cloud adoption in business and proper utilization of cloud services needed to be address. Puthal, Deepak, et al [7] conduct a survey to investigate current and future research challenges in cloud computing and classify the issues gathered from industry and academia. There are many critical factors that influence IT companies for the adoption of cloud technology [8].

To determine trends in cloud computing many studies perform SWOT (strength, weakness, opportunities and threat) analysis on cloud computing. The major factors that inhibit the adoption of the cloud computing paradigm regulation at the local, national and international level are organizational, environmental, management and technical factors. Additionally, Cloud computing also demands synchronized response from governmental organizations for implementation. Without proper infrastructure and basic resources for new technology an industry will never establish [9] .Priyadarshinee, Pragati, et al. conducted a SLR (systematic literature review) to investigate the critical of SMEs for the after adoption of cloud computing technology. Result show the major issue was IT risk management in cloud computing is critical. Study indicate also the need of empirical and theoretical research contributions for resolving the issues of SMEs for the adoption of cloud [10]. Assuncao, Marcos D., et al. [11] Present state of the art in the context of cloud-supported analytics. An analysis of business models for Cloud-assisted data analytics and other non-technical challenges were explored. The basic research directions of cloud computing are divided into two aspects i.e. business and technical aspects. Cloud computing is supposed to be a business model and developing countries face many business-related issues that need to be resolved. [12].

III. CRITICAL FACTORS IN CLOUD COMPUTING

Many applications move data over cloud platforms to leverage the benefits of cloud services. This study focuses on understanding the critical factors affecting adoption in different regions. Following Table shows the results from published empirical studies to determine the CSFs (Critical Success Factors) and CBs (Critical Barriers) for the adoption of cloud computing per business and technical aspects. Developed economies have strongly embedded cloud technology into their businesses. Despite the benefits of cloud computing, developing countries are still struggling to benefit from cloud computing technology. Nowadays not only giant corporations but also SMEs (Small and medium-sized enterprises) including American and European are embracing new technologies like cloud computing and its integration with latest technologies.

Table 1 identifies the key factors act as a barrier for the adoption of cloud technology. The major challenges for developing countries include: lack of research and development, lack of technical knowledge, poor infrastructure, lack of awareness, financial issue and data security issues etc. Second, we identify, the reason why companies need to adopt cloud services. These are business cost reduction, scalability, remote access etc. As discussed above there are two main aspects to research trends in cloud computing, namely technical and business aspects. In Table 1, shows the critical factors affecting cloud adoption for local companies.

For the instance, B refers to the Business factor and T refers to the technical factor. It is also mentioned that either, Business factor → B or Technical factor → T act as a challenge or key driver for moving towards cloud technology. After compiling the local factors affecting cloud adoption, results indicate that a lot of business factors act as a barrier to the adoption of cloud technology. Unfortunately, there is lack of literature available for resolving business related issues faced by SMEs and local industry the adoption of new technology. There is open research challenge to explore the challenges and solution for resolving the business aspects of cloud computing. The environmental and organizational conditions vary from region to region therefore to avail the significant benefit of cloud technology it is better to determine the local drivers. There are tremendous opportunities available to make groundbreakings research contributions in cloud computing and bring its significant impact on their own local industry.

TABLE 1 TRENDS IN CLOUD COMPUTING

Ref	Year	Region	Critical Success Factors (CSFs)	Critical Barriers (CBs)
[13]	2013	Cantabria, North of Spain - SME	Lack of research (B) Lack of knowledge (B) Security (T) Trust (B) Proper cost benefit analysis (B) changing suppliers (B) Legal data protection requirements (B)	Cost reduction (B) Access to better IT resources (B) Scalability (T) Accessibility (T) Flexibility (T)
[14]	2013	Kenya	Trading partner (B) Top management support(B) Investment (B) Technology adoption (B) Lack of knowledge (B) System modification (compatibility issues and complexity) (T)	Cost Reduction (B)
[15]	2013	Namibia- SMEs	Lack of Cloud Knowledge (B) Risk of Exposing Corporate Data (B) Privacy Concerns (T) High Latency Networks (T)	Flexibility (T) scalability (T)
[16]	2013	Korea	Lack of Experience (B) Lack of Guarantees (B) Lack of ability to serve Individually (B) Unfamiliar Brands (B) Distrust in Security (B) Lack of Understanding (B) Internal resistance Conservative Data locality Problems (T) Data security (T) Technological issues (B) Virtualization vulnerability (T) Integration (T) Lack of appropriate SLA standards (B) Lack of experts (B) Legal issues in Korea (B) Lack of technical standards (B)	Scalability (T) Reduced costs (B) Easy maintenance (T) Virtualization (T) Multi-tenancy (T) Open APIs (T)
[17]	2014	Saharan Africa.	Inadequate bandwidth speed (T) Cost issues (B) Security issues (T) Concerns about privacy and trust (T) Data loss concerns (T) Management support issues (B)	Startup new SME within low cost (B)
[18]	2014	Irish SMEs	Lack of time (B) Security concern (T) Data Ownership (T) Data Protection Concerns (T) Lack of awareness (B) Lack of IT skills (B) Lack of Resources (B) Inadequate Bandwidth Speed (T)	Cost Reduction (B) Improved Scalability (T) Improved Resource Utilization (T) Worker Mobility (T) Collaboration (T) Business Continuity (B)
[19]	2014	Czech Republic	Data security (T) Internet cost (T) Lack of knowledge (B) Unclear return (B) Financial issues (B) Lack of qualified staff (B) Technical infrastructure (T)	Cost reduction (B) Scalability (T) Flexibility (T) Automatic updates (T) Ubiquitous Access (T) Online support (T)
[20]	2014	South Africa – SME	Lack of Cloud Awareness (B) Lack of Suppliers (B) Bandwidth Cost (B) Quality and Data Security (T) Marketing Factors (B) Financial Issues (B) Management skills (B) Lack of Investment in ICT (B)	Cost Saving (B) Help SMEs to compete (B) Ubiquitous Access (T) Quick and Easy implementation (T)

[21]	2014	Latvian SMEs	Data security (T) Lack of awareness (B) Low knowledge (B)	Ubiquitous access (T) Reducing expenses on it solutions (B)
[12]	2015	India	Security (T) Privacy (T) Compatibility (T) Interoperability (T)	Cost effectiveness (B) Time and Effort Reduction (B) Government Support (B) Huge software and hardware firms (B) Research (T & B)
[22]	2015	Pakistan	Electricity short fall (B) Customers behavior (B) IS infrastructure (T) Government influence (B) Lack of Government support (B) Environmental Issues (B) Top management Support (B)	Data recovery (T) Mobile computing (T) Intelligent storage (T) Reduce energy consumptions (B)
[23]	2015	Palestinian	Lack of awareness (B) Insufficient financial resources (B) Shortage of cloud computing experts (B) Inadequate network bandwidth (T) Sensitivity of Data (T) Legal and Regulatory Issues (B) Compatibility with the existing it systems (T)	Sustainable Developmental (T) Eliminate The Problems of Licensing (B) Cost Reduction (B)
[8]	2016	Nigeria	Poor Internet Service (T) Fear of Hackers (T) Investment (B) Computing (T)	New Jobs (B) Cost reduction (B) Reduce capital expenditure (B) Creation of new services (T) Simple fast implementation (T)
[24]	2016	Oman	Service Providers' Support (B) Top Management Support (B) Investment (B)	Cost Benefits (B)
[25]	2016	Australia- SME	Less Innovative (B) Limited knowledge (B)	IT Technical Agility (T) Scalability (T) Enhancing Businesses Processes (B) Increasing Enterprises Competitiveness (B)
[26]	2016	England	Compatibility (T) Trialability (T) Top Management Support (B) Experience (B) Industrial Conditions (B) Market Scope (B) Supplier Efforts (B) External Computing Support (T)	Scalability (T)
[27]	2016	Bangladesh	Lack of knowledge (B) Cost (B) Data security (T)	Powerful software access (T) Ubiquitous data access (T)

As shown in the above table there are multiple factors act as an obstacle to the adoption of cloud in local industry. As per environmental condition and business need there are many reasons for moving towards cloud technology. Graphical representation of key reasons for adoption of cloud computing in different enterprise setting is shown in Fig. 2 and general challenges faced by local enterprises is shown in Fig. 3.

The results show that due to inadequate business practices local companies are unable to achieve the cloud computing technology. SMEs tries a variety of schemes for cost reduction in business [28], and hire extra human resources for this purpose [29]. Results of this study show that the maximum benefit an organization can achieve after applying cloud is cost reduction. Local industry can reduce the business setup cost, software licensing cost, software updating cost, infrastructure cost etc. by improving business practices. The best practices for improving the business processes are top management support, stakeholders have knowledge about latest technology (cloud computing), to investigate the benefits of emerging technologies. Common challenges for adoption of cloud computing include: lack of cloud computing knowledge/ awareness, limited resources, unstable local environmental conditions, poor management and security issues.

This section present the general cloud computing adoption factors. This section is based on empirical findings from research in recent years. Cloud computing provides different challenges. Classifications of these challenges are done based on cloud services and deployment models. Stakeholders from academia and business are progressively investigating the critical challenges associated with cloud service and deployment model for their applications. Using this information user can plan keeping in view potential risk may include in cloud computing service provisioning and so, they design best practices to overcome these challenges.
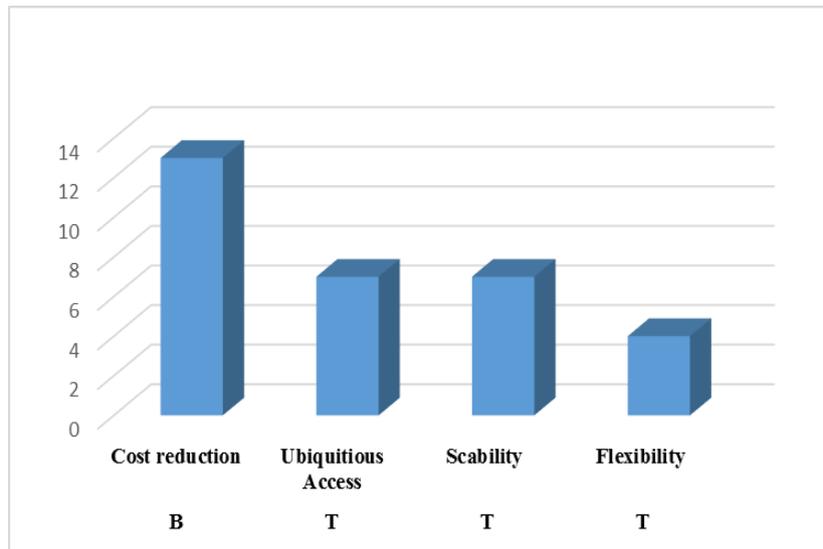
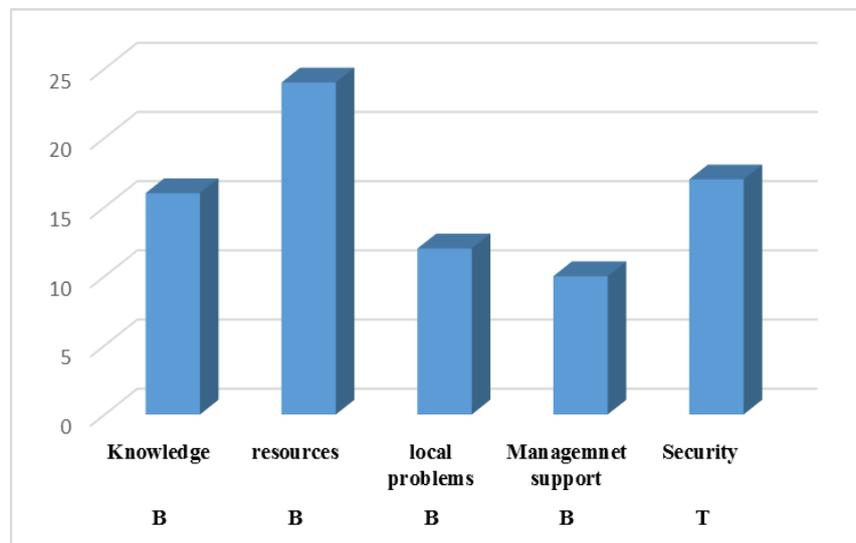Fig. 2. General reasons for the adoption of cloud computing

Fig.3. General challenges for the adoption of cloud computing

IV. CONCLUSION

In this article, we have presented the state of the art of trends in cloud adoption of in different geographical locations is presented. Cost reduction and ubiquitous access are the major factors for the adoption of cloud technology. Developing countries and SMEs have limited knowledge of benefits of cloud. Investment and environmental conditions act as a barrier for taking advantages from cloud service. This study foresees the adoption of cloud computing to grow exponentially and deliver huge benefits to small enterprises in the days to come.

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